

Avian Use of Forest Habitats in the Pembina Hills of Northeastern North Dakota



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By Craig A. Faanes
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Avian Use of Forest Habitats in the Pembina Hills of Northeastern North Dakota

by

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Abstract

North Dakota has the least extensive total area of forested habitats of any of the 50 United States. Although occurring in limited area, forest communities add considerably to the total ecological diversity of the State. The forests of the Pembina Hills region in northeastern North Dakota are one of only three areas large enough to be considered of commercial value. During 1981 we studied the avifauna of the upper valley of the Pembina River in the Pembina Hills. Field work extended from 20 April to 23 July; breeding bird censuses were conducted 7 June to 2 July. Of the 120 bird species recorded during the study period, 79 species were recorded during the breeding season. The total breeding population was estimated at nearly 76,000 breeding pairs. The wood warblers (Parulidae) were the most numerous family, accounting for about 28,000 breeding pairs. The yellow warbler (*Dendroica petechia*) was the most abundant breeding species, making up 19.4% of the population. American redstart (*Setophaga ruticilla*) was second in abundance, accounting for 10.5% of the breeding population. Largest breeding densities occurred in the willow (*Salix* sp.) shrub community. Although supporting the lowest mean breeding density, quaking aspen (*Populus tremuloides*) forests supported the highest species diversity. First State breeding records were recorded for alder flycatcher (*Empidonax alnorum*) and golden-winged warbler (*Vermivora chrysoptera*). Records were obtained for 12 species considered rare or unusual in North Dakota during the breeding season. The status of all species known to have occurred in the study area is described in an annotated species list.

Forest habitats in North Dakota occupy about 2% of the State's area (Stewart 1975). The Pembina Hills in Cavalier and Pembina counties represent a unique forest community because it is one of only two major deciduous forest ecosystems in the State. The heavily wooded Turtle Mountains in Bottineau and Rollette counties account for about half of the remaining forest area in North Dakota. Contributing to the uniqueness of the Pembina Hills is the fact that the Pembina River basin is a meeting area for three major North American ecosystems: Aspen Parkland, Tall Grass Prairie, and Eastern Deciduous Forest (U.S. Army Corp of Engineers 1976).

The breeding avifauna of the Pembina Hills is a unique aspect of North Dakota's resources. Stewart (1975) listed 14 species as primary indicators of this region, and 33 species as secondary indicators. Among these, ruffed grouse (scientific names of bird species are given in the Annotated Species

List), broad-winged hawk, ruby-throated hummingbird, yellow-bellied sapsucker, yellow-throated vireo, Philadelphia vireo, northern waterthrush, mourning warbler, and scarlet tanager are restricted primarily to the eastern third of the State, and attain their greatest breeding densities in the Pembina Hills or in the Turtle Mountains farther west.

The objectives of the present study were to determine densities and estimate the population size of breeding bird species, and describe the vegetative characteristics of the major forest and shrub habitats of the Pembina River gorge. Information is needed to assess the potential impact to the area of the Pembilier Dam, proposed by the U.S. Army Corps of Engineers to control floods downstream on the Pembina River. The resulting reservoir would permanently inundate at least 3.2 km² of woodland. Overall, about 12.1 km² of land would be affected. The reservoir would permanently inundate 15.3 km of free-flowing river, and 33.8 km of river would be inundated when under flood-water storage conditions (U.S. Army Corps of Engineers 1976).

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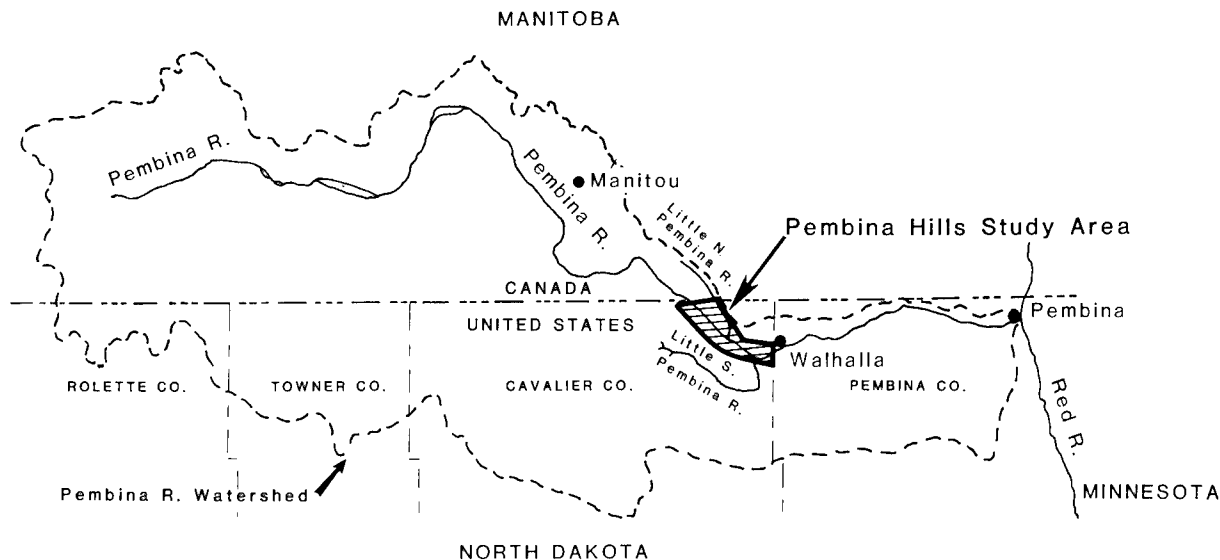


Fig. 1. Geographic location of the study area within the watershed of the Pembina River.

Study Area

Physiography

The Pembina River gorge lies entirely within the Drift Plain physiographic region of North Dakota (Arndt 1975). Land area included in the Pembina River drainage totals about 10,032 km² in southern Manitoba and northeastern North Dakota. The geographic location of the study area is shown in Fig. 1. Predominant bedrock of the region includes the Cretaceous age Carlisle and Niobrara formations which are made up primarily of shale overlain by deposits of glacial till occurring in varying depths. The Pembina Escarpment which forms the boundary of the Drift Plain and Red River Valley is the dominant physiographic feature of the region. Land use of the study area was primarily agricultural; farming activities were restricted to the flood-plain.

The climate is continental, with hot, dry summers and cold winters. Mean annual precipitation is about 50 cm (Simpson 1929). Mean June and July temperatures are 17.5 and 20.6° C (U.S. National Climatic Center 1981). In 1981, the year this study was conducted, precipitation for June was 5.2 cm above normal, and in July 3.7 cm below normal. Precipitation fell on 19 days in June and 10 days in July. Temperatures during June and July 1981 were 2.4 and 1.5° C below normal.

Habitats

Our study area extended upstream from the proposed dam site on the Cavalier and Pembina county lines to the Canadian border (Fig. 2). Five wooded habitats were predominant in the study area: bur oak (*Quercus macrocarpa*)

forest, quaking aspen (*Populus tremuloides*) forest, lowland forest, willow (*Salix* sp.) shrub, and serviceberry (*Amelanchier alnifolia*) thickets. The bur oak type was the most extensive.

Bur Oak Forest

Bur oak forest made up about 85.5% of the study area. It occurred on practically all topographic features of the study area except those directly adjacent to the Pembina River and its major tributaries. Predominant trees included bur oak and green ash (*Fraxinus pennsylvanica*). Subdominant tree species were quaking aspen, cottonwood (*Populus deltoides*), and American elm (*Ulmus americana*). Important components of the shrub layer included beaked hazelnut (*Corylus cornuta*), pin cherry (*Prunus pennsylvanica*), and serviceberry.

Quaking Aspen Forest

Quaking aspen forest occupied about 7.4% of the study area. Aspen occurred in "clones" of nearly homogeneous stands and in mixtures with bur oak. Predominant trees also included box elder (*Acer negundo*), white birch (*Betula papyrifera*), and American elm. Important shrub layer species were wolfberry (*Symphoricarpos occidentalis*), green ash saplings, beaked hazelnut, red-osier dogwood (*Cornus stolonifera*), and poison ivy (*Toxicodendron rydbergii*).

Lowland Forest

Lowland forest was restricted to lands adjacent to the Pembina River. This type was probably more extensive in the recent past, but has been reduced considerably by clearing for agricultural purposes along the valley floor where only small isolated stands remain. Currently, lowland for-

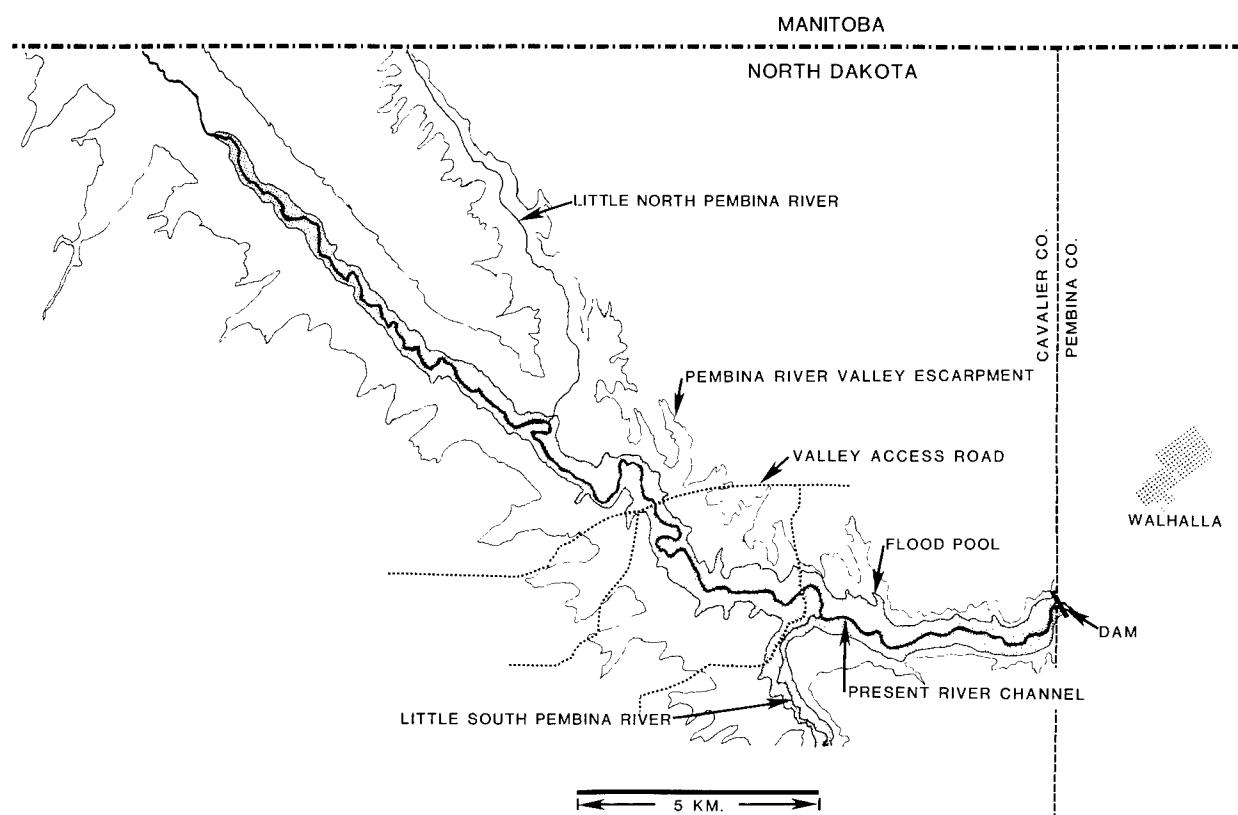


Fig. 2. Map of the Pembina Hills Study Area. The stippled area represents the full pool contour of the proposed impoundment.

est makes up about 1% of the study area. Predominant tree species included American elm, cottonwood, box elder, black ash (*Fraxinus nigra*), and peach-leaf willow (*S. amygdoloides*). In drier portions of the forest, bur oak and hackberry (*Celtis occidentalis*) were occasionally encountered. Important in the shrub layer were red-osier dogwood, chokecherry (*Prunus virginiana*), and highbush cranberry (*Viburnum opulus*). Lowland forest sites typically had well-defined canopy and understory layers.

Willow Shrub

Willow shrub made up about 5% of the study area and occurred in areas directly adjacent to the Pembina and Little South Pembina rivers. It was probably an early successional stage of regenerating lowland forest. The vegetation was dominated almost exclusively by peach-leaf willow. Red-osier dogwood and serviceberry were sub-dominant components of the community. Because of the early age of this habitat, no well-defined shrub layer or canopy had developed.

Serviceberry Thicket

Serviceberry thicket was rather limited, occupying about 1% of the area primarily along the drainage of the Little North Pembina River. The area occupied apparently had been recently burned, and serviceberry was the early suc-

cessional stage that became dominant. Serviceberry was the prevalent shrub species; red-osier dogwood and highbush cranberry occurred in scattered locations. As with the willow shrub community, no well-defined shrub or canopy layer had developed because of the young age of the habitat.

Methods

Census Plot Selection

Eleven census plots were established in the study area and an additional plot was located in the Deltaic Sand area south of Walhalla, Pembina County. Wherever possible, we attempted to locate plots in relatively homogeneous stands of habitat to allow for accurate estimates of bird population sizes by habitat type. Thus, in several instances, plot size was smaller than normally recommended. Area of each major census plot was determined from aerial photographs (scale 1:15,840).

Census Techniques

Breeding bird populations were censused during 7 June to 2 July 1981 by the spot-mapping method (Williams 1936). Each of 11 census plots was visited 6 times during

the count period. Count times were usually from local sunrise to no later than 1100. Several early evening counts were made to census thrush (*Turdidae*) populations. The starting and ending point in each plot was changed with each count to ensure uniform coverage during all periods of the morning or evening.

In addition to census plots, periodic investigations of major habitats throughout the study area were made to record the presence of additional species not found on census plots. These data were used to compile a more complete species list for the study area. The results of these investigations are provided in the Annotated Species List.

Observations of bird use of the study area were concentrated primarily during the breeding season. Several other trips were made to gather data on species using the area during migration. Data from the migration periods are incomplete and should not be considered as estimates of population density.

Data Analysis

Populations of breeding birds were estimated from the number of indicated pairs encountered on census plots. Densities reported for each species are expressed as pairs per square kilometer. Population estimates for breeding birds follow the methods described by Faanes (1982), including the calculation of highest probability density (HPD) intervals (Johnson 1977). Bayesian confidence intervals were used because the number of breeding pairs is known to be non-negative, and because HPD intervals are more precise. The species diversity index, H' (Tramer 1969), was calculated for each habitat type.

Breeding bird densities were calculated by determining the number of territories on each plot. After completing the censuses, composite maps delineating territorial boundaries were compiled for each species on each census plot. For individuals recorded 3–4 times, or those having only a portion of their territory on the plot, a density of

0.5 pair was given. Species recorded 2 times on a plot were assigned a density value of 0.3 pair per plot. Species recorded once were typically considered to be visitors, i.e., probably breeding in the area but not on the census plot, and were assigned a density of 0.1 pair per plot. These density figures, especially for diurnal raptors, appeared to be close to the number of presumed breeding pairs encountered throughout the study area.

Vegetation

We quantified vegetation on each census plot using the methods of James and Shugart (1970). Habitat variables evaluated on each census plot are summarized in Table 1. These data were used to determine important components of the habitat occupied by each species in the study area. Vegetation sampling was conducted on each bird census plot during 21–22 July.

Results and Discussion

Vegetation Analysis

Quaking Aspen Forest

Six tree species were recorded in this habitat. Mean values among characteristic tree species indicated that quaking aspen was highest in both relative dominance (57.2%) and relative density (54%). Dead quaking aspen trees, important for natural nest cavities and perch sites, made up 18.7% of dominance and 16% of density. Green ash was third in density (11%) and American elm was third in dominance (9%).

This habitat supported the highest number of trees per hectare among all types (Table 1), especially "pole"-stage trees (7.6–22.8 cm in diameter). This relates both to the growth form of quaking aspen and the relative age of the forest. Most quaking aspen in the study area was approach-

Table 1. *Vegetative characteristics of forest habitats in the Pembina River study area, North Dakota, 1981.*

| Characteristic | Quaking aspen | Lowland forest | Bur oak | Willow shrub | Serviceberry thicket |
|----------------------------------|---------------|----------------|---------|--------------|----------------------|
| Trees per hectare | 595 | 492 | 178 | 7.4 | 0 |
| Basal area (m ²) | 3.8 | 5.4 | 1.2 | 0.03 | 0 |
| Trees by diameter class (cm) | | | | | |
| 7.6–15.2 | 85 | 65 | 23 | 1.5 | 0 |
| 15.2–22.8 | 32.5 | 22 | 8 | 0 | 0 |
| 22.8–38.1 | 3 | 8 | 7 | 0 | 0 |
| 38.1–53.3 | 0 | 3 | 0 | 0 | 0 |
| 53.3–68.6 | 0 | 1 | 0 | 0 | 0 |
| Shrub density (no. stems per ha) | 36,000 | 16,533 | 120,533 | 131,200 | 179,800 |
| Percent ground cover | 77 | 61 | 83 | 61 | 100 |
| Percent canopy cover | 47.5 | 75 | 27 | 5.5 | 0 |
| \bar{x} vegetation height (m) | 9.6 | 15.4 | 5 | 2.7 | 1.8 |

ing old age. Canopy cover of 47.5% and the relatively high ground cover (77%) were related to the density of dead quaking aspen in the forest. Subsequent increases in penetration of sunlight to the forest floor resulted in high ground-cover values.

Shrub density in quaking aspen was second lowest among all forest types and resulted in substantial areas of growth among herbaceous plants in the ground level. Most of the shrubs were serviceberry, highbush cranberry, and green ash. The distribution of shrubs in the forest was related to the presence of openings in the canopy caused by dead trees. Percent ground cover was third highest in aspen forest. The low number of shrubs was one indication that the forest had recently reached maturity, and suggested that the forests on the study area were approaching the climax stage.

The herbaceous layer was composed primarily of poison ivy, various forbs, and Pennsylvania sedge (*Carex pennsylvanica*). This provided a double layering effect in the ground layer with an upper "canopy" of poison ivy about 0.5 m high, and a lower layer composed of forbs and grasses. Thus, a mosaic of several levels occurred within the ground and shrub layers.

Lowland Forest

Five tree species were recorded in the lowland forest plots. American elm was highest in relative dominance, but box elder was highest in relative density. Thus, although there were more box elder trees present (density), the size of the American elm (dominance) trees exerted greater influence on the volume of woody vegetation present in the forest. Relative density of American elm was only 16.7%, suggesting that few were in the forest, but those present were large.

Black ash was second highest in relative density and third in relative dominance. This species is rare in North Dakota; its distribution is restricted to the extreme northeastern corner of the State. Cottonwood made up 13.2% of relative dominance and 14.2% of density. Peach-leaf willow was a relatively unimportant component of this community, making up 1.3% of dominance and 3.0% of density.

Lowland forest supported the second highest number of trees per hectare. The distribution of trees within various diameter classes in the lowland forest showed the greatest amount of variation of all habitat types; trees ranged from 7.6 to 61 cm in diameter. All trees greater than 22.9 cm in diameter were American elm. High basal area and dominance by American elm is a regular characteristic of lowland forests east of the Great Plains.

Canopy cover was greatest in lowland forest, and percent ground cover and shrub density were the lowest among all habitats. The high percentage of canopy cover is characteristic of mature lowland deciduous forests. The low values for shrub density and percent ground cover in lowland forest are related to reduced sunlight reaching lower layers of the forest. The result is a well-defined canopy layer

and a well-defined ground layer, with a poorly developed shrub layer.

The ground layer was dominated by an extensive growth of wood nettle (*Laportea canadensis*). Individual wood nettle plants were widely spaced, and leaves were large and broad in response to reduced sunlight. Few herbaceous plants grew below the layer of nettle leaves, which resulted in many areas of bare soil.

Mean vegetation height was highest in lowland forest. This was a reflection of the growth form of typical lowland forest tree species and was related to the generally mesic to wet-mesic character of the community.

Bur Oak Forest

The bur oak forest represented the most xeric habitat in the study area. Distribution of this type was primarily on drier south-facing slopes, and, in many instances, was associated with scattered openings supporting native prairie grasses.

The mean number of trees per hectare in bur oak forest ranked third among all habitat types (Table 1). Considerable variation existed within the stands studied. This variation was probably caused by past fire activity which resulted in the vegetation of one plot supporting only 79 trees per hectare.

Distribution of trees within each diameter size class reflected the low number of trees in this habitat and the relative age of the forest. Over 60% of the trees were less than 15 cm in diameter. The mean of 7 trees/ha in the 22.9- to 38.1-cm class reflected older bur oak trees.

A dramatic increase in the shrub density was related primarily to the relatively young age of this forest type. The mean shrub density in bur oak forest was over 3 times greater than in quaking aspen forest. The shrub layer was dominated primarily by bur oak saplings ranging from 1 to 2.5 m tall. Serviceberry was of minor importance. Regeneration of green ash was not apparent.

Canopy cover was 27%, which was about 64% lower than the mature lowland forest. Percent ground cover was second highest among all habitats and reflected the open nature of this forest type. Mean height of canopy was the lowest of all habitats studied. Range of canopy height was 3.0–8.3 m, another indication of the young age of the forest and probably poorer growth on drier soils.

Willow Shrub

The willow shrub community was composed almost entirely of peach-leaf willow. The mean number of trees per hectare was lowest among all habitats supporting trees (Table 1). Basal area and trees by diameter class reflected the low frequency of trees in this habitat. Willow shrub occurred exclusively in a narrow band adjacent to the Pembina River. Mean height of vegetation was 2.7 m. Height of peach-leaf willows was uniform throughout the

study area, which suggested a relatively even-aged community.

Shrub density was second highest among all habitats. Most shrubs were in the 2.5- to 5.0-cm size class. Percent canopy cover was 5.5% and ground cover was 61.5%. Ground layer vegetation consisted primarily of various grasses and sedges; there were few forbs present. In other habitats studied, there was a direct relation between canopy and ground cover. However, in the willow shrub community the relation was reversed. Although there was little canopy cover, ground layer vegetation was poorly developed. This was probably related to the sandy soils prevalent throughout much of the floodplain.

Serviceberry Thicket

This distinct community occurred within the floodplain of the Pembina and Little North Pembina rivers, but on better-drained soils that appeared to contain higher amounts of silt and loam. No trees greater than 3 m high were identified in the area studied (Table 1). Percent ground cover was the highest of all habitats studied. Ground-layer vegetation consisted of several grasses and small raspberry bushes (*Rubus* sp.). Shrub density was the highest of all study sites and the mean vegetation height was lowest. Shrub density consisted primarily of serviceberry, although red-osier dogwood occurred in scattered patches.

Avian Use

In the study area 120 bird species were recorded in 1981. The most recent compilation of North Dakota birds indicates that 353 valid species have been recorded in the State (Faanes and Stewart 1982). Thus, 34% of the total avifauna of the State was recorded in the Pembina River gorge during April–September 1981. The breeding avifauna consisted of at least 79 species for which evidence of nesting was obtained.

Stewart (1975) listed 196 species that nest, have nested, or probably nest in North Dakota. The 79 breeding species recorded in the Pembina River gorge represented 40.3% of the known breeding avifauna of the State. One major factor limiting the number of breeding birds in the Pembina River gorge is the absence of prairie wetlands, which are common across most of the State. Stewart (1975) listed about 152 bird species that nest regularly in the eastern half of North Dakota (east of 100° W longitude). Of these, 44 (or 29%) are associated with prairie wetlands. Removing these from the total, there are 108 breeding species that are not associated with wetlands in eastern North Dakota. The Pembina River gorge supported 73.1% of this avifauna of eastern North Dakota in 1981.

Breeding Bird Populations

Fifty-seven breeding bird species were recorded on the

census plots. Records were obtained for an additional 22 species that probably nested in the study area. These species were recorded during supplemental surveys throughout the study area. Among the 57 species recorded in census plots, data for 7 were not used in the population estimates or in calculation of various habitat variables. These species (red-tailed hawk, broad-winged hawk, American woodcock, belted kingfisher, golden-winged warbler, orange-crowned warbler, and Canada warbler) occurred locally in the study area and populations were represented by 1–15 pairs. However, because expansion of the population data would result in grossly overestimated figures, these species were not included.

The breeding avifauna was dominated by the order Passeriformes, but included nine non-passerine species represented by 4,619 pairs, or about 6.1% of the total. Orders other than Passeriformes were Columbiformes (2,422 breeding pairs), Apodiformes (1,730), Piciformes (254), Galliformes (126), Cuculiformes (71), Accipiteriformes (8), and Meleagridiformes (8).

The breeding avifauna included 21 families. The Parulidae (wood warbler) were most abundant with seven species and an estimated population of over 28,000 breeding pairs (Table 2). The sparrow family (Fringillidae) was second in abundance with seven species and an estimated population of over 17,500 pairs. Five families representing 23 species made up about 80% of the population.

Based on census plot data, the total breeding population in the study area was estimated at 75,972 breeding pairs (HPD interval, 58,166–79,899 breeding pairs). Twenty species made up about 90% of the population; five species made up over 51% of the total (Table 3).

The yellow warbler was the most abundant breeding species, making up 19.4% of the total breeding population. This species was recorded in all habitat types investigated, reaching highest density in the willow shrub community. The American redstart was second in total abundance. The estimated breeding population of 7,973 pairs was 10.5% of the total avifauna breeding population. Breeding American redstarts occurred only in the more mature forest habitats. Largest breeding densities were in bur oak forest. The clay-colored sparrow was third in total abundance. The estimated breeding population of 7,226 pairs represented 9.5% of the total. Largest breeding densities were in the serviceberry community and in young bur oak forest.

Included in the total breeding avifauna were species not recorded on census plots. These species included waterfowl, shorebirds, swallows, and raptors, which normally have either large, wide-ranging territories or nest in colonial or semi-colonial associations. Although not of numerical significance, these species were unique components of the avifauna. The total breeding population of these species, based on intensive observations throughout the area, was estimated at 290 pairs. This represented less than 0.4% of the projected population of breeding birds.

Table 2. *Estimated population sizes and breeding densities of bird families in the Pembina River study area, North Dakota, 1981.*

| Family | Number of species | Estimated population | Percent total | Density pairs per | |
|---------------|-------------------|----------------------|---------------|-------------------|-----------|
| | | | | km ² | 100 acres |
| Parulidae | 7 | 28,082 | 36.96 | 369.89 | 149.75 |
| Fringillidae | 7 | 17,504 | 23.04 | 230.56 | 93.34 |
| Mimidae | 1 | 5,338 | 7.03 | 70.31 | 28.47 |
| Tyrannidae | 6 | 5,269 | 6.93 | 69.40 | 28.09 |
| Turdidae | 2 | 3,879 | 5.10 | 51.09 | 20.68 |
| Vireonidae | 5 | 3,282 | 4.32 | 43.23 | 17.50 |
| Bombycillidae | 1 | 2,933 | 3.86 | 38.63 | 15.64 |
| Columbidae | 1 | 2,422 | 3.19 | 31.90 | 12.91 |
| Trochilidae | 1 | 1,730 | 2.30 | 22.78 | 9.22 |
| Thraupidae | 1 | 1,550 | 2.04 | 20.41 | 8.26 |
| Icteridae | 3 | 1,451 | 1.91 | 19.11 | 7.73 |
| Paridae | 1 | 1,409 | 1.85 | 18.55 | 7.51 |
| Picidae | 3 | 254 | 0.33 | 3.34 | 1.35 |
| Sittidae | 1 | 243 | 0.32 | 3.20 | 1.29 |
| Corvidae | 3 | 235 | 0.31 | 3.09 | 1.25 |
| Troglodytidae | 1 | 148 | 0.20 | 1.94 | 0.78 |
| Tetraonidae | 1 | 126 | 0.17 | 1.65 | 0.67 |
| Cuculidae | 1 | 71 | 0.09 | 0.93 | 0.38 |
| Hirundinidae | 2 | 30 | 0.03 | 0.39 | 0.16 |
| Accipitridae | 1 | 8 | 0.01 | 0.10 | 0.04 |
| Meleagrididae | 1 | 8 | 0.01 | 0.10 | 0.04 |
| Totals | 50 | 75,972 | 100.00 | 1,000.61 | 405.66 |

Table 3. *Estimated populations and mean densities of major breeding bird species in the Pembina River study area, North Dakota, 1981.*

| Species | Mean density per | | Estimated population | Percent total population |
|---------------------------|------------------|-----------|----------------------|--------------------------|
| | km ² | 100 acres | | |
| Yellow warbler | 194.1 | 78.6 | 14,739 | 19.40 |
| American redstart | 105.0 | 42.5 | 7,973 | 10.50 |
| Clay-colored sparrow | 95.2 | 38.5 | 7,226 | 9.51 |
| Gray catbird | 70.3 | 28.5 | 5,338 | 7.03 |
| Veery | 50.9 | 20.6 | 3,867 | 5.09 |
| American goldfinch | 47.3 | 19.1 | 3,591 | 4.73 |
| Common yellowthroat | 47.0 | 19.0 | 3,571 | 4.70 |
| Cedar waxwing | 38.6 | 15.6 | 2,933 | 3.86 |
| Rufous-sided towhee | 33.7 | 13.7 | 2,562 | 3.37 |
| Mourning dove | 31.9 | 12.9 | 2,422 | 3.19 |
| Ruby-throated hummingbird | 22.8 | 9.2 | 1,730 | 2.27 |
| Red-eyed vireo | 22.2 | 8.9 | 1,685 | 2.22 |
| Least flycatcher | 20.7 | 8.4 | 1,572 | 2.10 |
| Scarlet tanager | 20.4 | 8.3 | 1,550 | 2.04 |
| Black-capped chickadee | 18.6 | 7.5 | 1,409 | 1.85 |
| Rose-breasted grosbeak | 18.4 | 7.4 | 1,394 | 1.83 |
| Song sparrow | 16.7 | 6.8 | 1,272 | 1.67 |
| Alder flycatcher | 16.4 | 6.6 | 1,242 | 1.63 |
| Warbling vireo | 16.3 | 6.6 | 1,235 | 1.62 |
| Indigo bunting | 16.0 | 6.5 | 1,213 | 1.60 |

Habitat Distribution of Breeding Birds

Lowland Forest

The highest calculated species diversity index and second highest mean density of breeding birds per square kilometer occurred in lowland forest (Table 4). Thirty-two breeding bird species were recorded on the lowland forest census plots and 12 species reached their highest mean density per square kilometer in this habitat, including American robin, black-billed magpie, great crested flycatcher, eastern kingbird, eastern phoebe, hairy woodpecker, least flycatcher, mourning dove, red-eyed vireo, rose-breasted grosbeak, ruffed grouse, and warbling vireo. The black-billed magpie was recorded only in this habitat.

Among breeding birds, the yellow warbler was the most numerous species in lowland forest, making up 15.4% of total abundance. The veery (7.7%) and least flycatcher (7.2%) were second and third in abundance. Only six species accounted for about 50% of total abundance, and 14 species made up 80% of the population. The warbler family represented by four species was most numerous, making up 18.5% of total abundance. The flycatchers represented by five species accounted for 17.9% of abundance.

Case (1964) reported a similar density from Illinois floodplain forests, where six species (indigo bunting, American redstart, red-eyed vireo, cardinal (*Cardinalis cardinalis*), great crested flycatcher, and eastern wood pewee) accounted for 50% of total abundance. Fourteen of the 41 species recorded in Case's study area are typical of the southeastern United States. Stamp (1978) reported a mean density of about 1,689 pairs/km² from riparian cottonwood forests in south-central Arizona. Finches and doves collectively made up over 35% of total abundance on Stamp's study area.

The vertical distribution of breeding birds in lowland forest was remarkably uniform. Among 30 species that could be classified to vertical stratification, 12 were characteristic of the shrub layer, 10 were characteristic of the mid-level, and 8 were primarily canopy-nesting species. This degree of stratification was one factor responsible for the high species diversity exhibited in lowland forest.

Quaking Aspen Forest

The estimated density of breeding birds in quaking aspen forest was the lowest of all habitats studied (Table 4). Species diversity ranked second and species richness ranked first. Thirty-eight breeding bird species were recorded on quaking aspen census plots. Ten species (wild turkey, black-billed cuckoo, downy woodpecker, yellow-bellied sapsucker, eastern wood pewee, black-capped chickadee, white-breasted nuthatch, Philadelphia vireo, black-and-white warbler, and northern oriole) reached their highest mean breeding density in this habitat.

Least flycatcher was the most numerous breeding bird species in quaking aspen (about 12% of total abundance).

Eight species (least flycatcher, veery, yellow warbler, mourning dove, red-eyed vireo, black-and-white warbler, American redstart, and American goldfinch) made up over 50% of total abundance. About 85% of the population was made up by 22 species. The warbler family, represented by six species, was most numerous (21.6% of the population). The flycatchers represented by four species made up about 29%, thrushes with two species accounted for 9.3%, and vireos with three species made up 9.1%.

Quaking aspen forest supported seven species that exhibit a limited breeding range in North Dakota. Most unusual were Philadelphia vireo and mourning warbler. Both species are restricted in the State almost exclusively to the Pembina Hills region or the Turtle Mountains. Five species (wild turkey, black-billed cuckoo, eastern wood pewee, Philadelphia vireo, and northern oriole) occurred only in quaking aspen forest in the study area.

Breeding bird densities in mature and pole-stage aspen forests are variable across broad geographic areas (Back 1979). Erskine (1969) reported 326 pairs/km² from a mature New Brunswick aspen forest. The ovenbird was the most abundant species, making up nearly one-third of the breeding population. Sixteen species were found on Erskine's study area including seven that did not occur in the Pembina Hills. Erskine (1972) reported 520 pairs/km² from a mature aspen forest in west-central Manitoba. Fifteen species were recorded including four not found on Pembina Hills aspen forest plots.

Densities ranged from 225 pairs/km² in Saskatchewan to 852 pairs/km² in North Dakota among five pole-stage aspen forests analyzed (Back 1979). In both pole-stage and mature aspen forests, the ovenbird was the most abundant breeding bird species. The veery and red-eyed vireo were second and third in abundance in pole-stage forests. The red-eyed vireo and least flycatcher were second and third in abundance in mature aspen forest. Breckenridge (1956) pointed out that the degree of openness in the canopy was an important component of least flycatcher habitat. Canopy cover in quaking aspen forests of the Pembina Hills was 47.5%, thus providing a degree of openness almost identical to the conditions described by Breckenridge. Erskine (1972) reported that least flycatchers on his Manitoba study area were restricted to areas of mature quaking aspen.

An important factor influencing the high species richness in quaking aspen was the well-developed growth of saplings in the shrub layer. Erskine (1972) attributed the exceptionally high density of American redstarts on his study area to dense growth in the shrub layer. Nearly 40% of the breeding birds recorded in quaking aspen forest on our study area were associated with the shrub layer.

Dead quaking aspen accounted for about 19% of forest dominance in the Pembina Hills. Dead trees are a source of natural cavities and are frequently mentioned for their importance in "snag" management. Dead trees also provide frequent openings in the canopy that are regularly used by eastern wood pewees for song perches. About 18% of

Table 4. *Characteristics of breeding bird populations among major forest habitats, Pembina River study area, North Dakota, 1981.*

| Habitat | Number of species | Mean density (pairs/km ²) | Species diversity (H') |
|----------------------|-------------------|---------------------------------------|------------------------|
| Lowland forest | 32 | 1,311 | 3.647 |
| Quaking aspen | 38 | 723 | 3.641 |
| Willow shrub | 19 | 2,207 | 3.006 |
| Serviceberry thicket | 14 | 807 | 2.936 |
| Bur oak forest | 34 | 847 | 2.866 |

the breeding avifauna of quaking aspen forest were species that typically nest in cavities. The two most numerous species were black-capped chickadee and yellow-bellied sapsucker.

Bur Oak Forest

The second highest species richness among habitats was recorded in bur oak forest. This habitat supported the lowest species diversity and one of the lowest total breeding densities (Table 4). Thirty-four breeding bird species were recorded on bur oak census plots, and 10 species reached their highest mean density per square kilometer there: American redstart, ruby-throated hummingbird, blue jay, indigo bunting, scarlet tanager, mourning warbler, vesper sparrow, yellow-throated vireo, common crow, and house wren. Among these species, indigo bunting, vesper sparrow, and yellow-throated vireo were restricted to bur oak forest.

Among breeding birds, the yellow warbler was the most numerous species in bur oak forest, making up 18.7% of total abundance. American redstart was second in abundance (12.5%) and clay-colored sparrow third (10.5%). Five species made up 50% of total abundance and 16 species made up 80% of the population. The warbler family, represented by five species, made up 39.3% of the population in bur oak. Sparrows (three species) made up 13.6% of the population, finches made up 9.1%, and vireos accounted for 7.1% of the population.

Probst (1979) observed that species richness in oak forests ranged from 9 to 29 species, with a mean of 21.2. Mean breeding density ranged from 160.5 to 963.3 pairs/km², with a mean of 548.3. Probst also noted that mesic stands can have higher densities than xeric stands. Anderson (1970) reported a mean density of 1,358.5 pairs/km² in Oregon white oak (*Quercus garryana*) forests. Anderson suggested that the stage of succession of Oregon white oak forests was an important factor in supporting the exceptionally high density of breeding birds he observed.

Anderson (1970) also argued that western oak forests supported lower numbers of permanent residents among breeding birds. MacArthur (1959) reported that about 90% of eastern oak forest breeding bird species were migratory. About 82% of the breeding bird species occupying bur oak forests in the Pembina Hills were migratory.

Density of breeding birds in bur oak forests was related to several vegetative factors including successional stage,

canopy cover, and density of the shrub layer. Eighteen species on our study plots were indicative of early successional stage vegetation. Also, three species not included in the population analysis for bur oak forest (American woodcock, golden-winged warbler, and orange-crowned warbler) were recorded only in early successional-stage bur oak forest. Seven of the 10 species reaching maximum density in bur oak were characteristic of early successional-stage vegetation.

The diversity of bur oak forest breeding birds was divided equally between ground-foraging seedeaters and canopy or sub-canopy flycatchers (nine species each). Also, an equal number of foliage gleaners and ground-layer insect eaters (five species each) were observed. Bond (1957) reported that foliage gleaners and ground-feeding insectivores were more common in mesic forests and plant eaters were more common in xeric forests.

Probst (1979) found that the highest number of birds in oak forests were ground foragers. Predominant among these were the thrushes, rufous-sided towhee, and ovenbird. Ground cover was second highest in bur oak forest and serviceberry was an important shrub layer species. Although quantitative data are lacking, sizable populations of flying insects were observed in the shrub layer of bur oak forest. During late June, an abundance of ripe seeds was present, which was heavily exploited by most ground- and shrub-layer foraging species.

Willow Shrub Community

The highest mean density of breeding birds and the third highest species diversity were recorded in the willow shrub community (Table 4). Nineteen breeding bird species were recorded on willow shrub census plots. Twelve species reached their highest mean density per square kilometer in this habitat: alder flycatcher, bank swallow, barn swallow, brown-headed cowbird, cedar waxwing, common yellowthroat, gray catbird, northern waterthrush, red-winged blackbird, song sparrow, veery, and yellow warbler. No species was restricted entirely to this habitat.

Among breeding birds, the yellow warbler was the most numerous species in willow shrub, making up 25.7% of total abundance. The alder flycatcher (12.9%) and song sparrow (10.6%) were second and third in abundance. These three species collectively accounted for about 50% of the total breeding population in the willow shrub community. Eight species accounted for about 80% of the popu-

lation. The warbler family, represented by three species, made up 38.5% of the population. Sparrows and flycatchers, each represented by two species, made up 13.6 and 13.2% of the population.

The breeding bird density recorded in the willow shrub community was nearly twice as large as any other habitat type in the study area. The general pattern of succession in avian communities suggests that diversity and populations increase from bare ground and grasslands through early seral stages and non-mature forests to maximum diversity in mature mixed forests. Diversity and species abundance decline when forests approach climax stage. Along this gradient, the willow shrub community would occupy one of the lower levels of succession.

Because the willow shrub community is poorly studied, few comparative data are available. Baumgartner and Slack (1977) studied a structurally similar shrub community in New York. On their plot (9.3 ha), 15 species were recorded and the mean density was 892 pairs/km². A second New York plot of similar size examined by Lucid et al. (1977) supported 16 species and 505 pairs/km². On both of these New York study areas, the yellow warbler was overwhelmingly the most numerous breeding bird species. On Baumgartner and Slack's area, the yellow warbler made up 31.3% of the population and on the plot studied by Lucid et al., about 20% of the population. Six species were common to both our North Dakota study area and the New York plots. The willow flycatcher (*Empidonax trailii*) replaced the alder flycatcher in New York, although abundance on one plot was practically identical to the mean values reported here.

The yellow warbler population occupying willow shrub in the Pembina Hills is probably indicative of maximum habitat exploitation by a species. Morse (1966) reported that yellow warblers on his study area favored wet areas supporting alders (*Alnus* sp.) and willow, 1 to 4 m high. Kendeigh (1941) reported exceptionally high yellow warbler densities in wolfberry thickets associated with prairie grasslands. An important component of these habitats was the presence of numerous elevated song perches. As Morse (1966) reported, usually the only other Parulid associated with the yellow warbler was the common yellowthroat. The willow shrub community in the Pembina Hills supported three Parulids: yellow warbler, common yellowthroat, and northern waterthrush. The yellowthroat and waterthrush forage at ground level.

Willow shrub in the Pembina Hills was a prominent edge habitat. The importance of ecotonal areas to breeding bird species abundance has been reported extensively. On our study area, willow shrub typically occurred at the edge of mature lowland forests, in wet areas of overlap between quaking aspen and lowland forest, and in areas bordering the Pembina River. Because most willow shrub communities existed as patches of similar vegetation adjacent to more advanced seral stages, many breeding bird species occupied this habitat as a part of their overall breeding territory. This

overlap in habitat use, especially evident in the song sparrow, gray catbird, common yellowthroat, and veery, greatly increased total avian use, and the perceived number of breeding territories was correspondingly higher.

Serviceberry Thicket

The lowest number of breeding bird species was recorded in the serviceberry thicket (Table 4). Mean breeding density per square kilometer and species diversity were second lowest among all habitats studied. Fourteen breeding bird species were recorded in serviceberry thickets. Four species reached their highest mean density per square kilometer: clay-colored sparrow, American goldfinch, solitary vireo, and chestnut-sided warbler. The vireo and warbler were recorded only in this habitat.

Among breeding birds, the yellow warbler was the most numerous species, making up 28.6% of total abundance. Clay-colored sparrow was second and American goldfinch was third. These three species collectively accounted for nearly 62% of the total population. Three species of the warbler family made up about 39% of the population in serviceberry thickets, two species of sparrows made up 19.8%, and the one finch accounted for over 14%.

The serviceberry thicket is a community occurring in limited extent at the forest-prairie ecotone. Because of its limited extent, virtually no previous field work has been conducted in this community. The vegetative structure characteristics are similar to other early successional stage habitats, so generalized statements and comparisons can be made.

The breeding birds of this community were dominated by ground-foraging species including gray catbird, common yellowthroat, cedar waxwing, veery, song sparrow, and brown-headed cowbird. Ground-layer flycatchers were represented by yellow warbler, least flycatcher, solitary vireo, and chestnut-sided warbler. The lack of trees in this community precluded use by higher-level flycatching species, although eastern kingbirds were regularly observed hunting over adjacent areas of similar habitat.

Serviceberry thicket appears to be an intermediate, early seral stage in the succession of bur oak forest. Although serviceberry and red-osier dogwood were the predominant shrub species present, chokecherry and sapling bur oak were occasionally encountered. Examination of plant data for the bur oak forest revealed that serviceberry and red-osier dogwood were the most numerous species in the shrub layer. Thus, through normal succession, this community can be expected to develop bur oak forest as the next seral stage.

Breeding bird composition of serviceberry thickets was very similar to bur oak forest; 12 species were common to each habitat. The rufous-sided towhee was conspicuously absent from serviceberry thickets, although it was one of the more common species in bur oak. Shrub density was one-third greater in serviceberry thickets than in bur oak, resulting in a very dense vegetation layer close to the

ground. Ground cover was 17% more open in bur oak, which probably allowed more foraging space for towhees to use.

Habitat characteristics of yellow warbler territories, as discussed earlier, would suggest that although elevated song perches were generally lacking, serviceberry thickets provided most of the important components of yellow warbler breeding habitat. A primary characteristic of clay-colored sparrow breeding habitat is the clumped arrangement of wolfberry patches (Stewart 1975; Kantrud 1981; Faanes 1982). Serviceberry thickets are structurally similar, at least outwardly, to wolfberry clumps. Thus, the heavy use of serviceberry by clay-colored sparrows was not unexpected. Our observations are the first, however, of heavy use of Saskatoon serviceberry by clay-colored sparrows (Kantrud 1981).

Conclusion

The habitats of the Pembina River valley of North Dakota are at the periphery of their distributions. Populations of many species with eastern or western, northern or southern affinities meet there. This was evident both with plant and avian species. Ground-layer vegetation of some quaking aspen forests on north-facing slopes supported wild ginger (*Asarum canadense*), which is indicative of moist southeastern forests, growing in profusion with Canada mayflower (*Maianthemum canadense*), a species typical of moist northern mixed coniferous-deciduous forest. Similar associations were evident with bird species. Clay-colored sparrows and black-billed magpies, both primarily western species, occurred on the same lowland forest census plot with eastern species such as mourning warbler and ruby-throated hummingbird. Quaking aspen forest supported the Philadelphia vireo, which is characteristic of the Canadian Aspen Parkland, along with clay-colored sparrow and scarlet tanager.

An outstanding feature of the Pembina River gorge forests was their well-developed understory and numerous brushy edges that flourished in the absence of grazing by domestic livestock. Across much of North Dakota, livestock grazing has impacted riparian vegetation. Most of the Little Missouri River forest community outside Roosevelt National Park is heavily grazed. Much of the riparian forest habitat along the remaining unflooded portion of the Missouri River is heavily grazed and regeneration of saplings occurs only in isolated stands. In the extensive forests of the Turtle Mountains, only public lands are not being grazed.

The breeding warblers of the Pembina Hills were among the most unique aspects of the avifauna. Stewart (1975) listed 14 warbler species that occurred in North Dakota during the breeding season. Among these species, 10 were present on our study area. We also found one breeding pair of golden-winged warblers on territory. A nest found 30 June was the first recorded for North Dakota. Thus, 11 warbler species were present during the breeding season.

Of the four warblers listed by Stewart (1975) that were not found on our study area during the breeding season, the Tennessee warbler and cerulean warbler (*Dendroica cerulea*) have been recorded a total of only 8 times during the breeding season in North Dakota; yellow-rumped warblers occur only in pine forests of extreme western North Dakota, and yellow-breasted chat (*Icteria virens*) occupies dry thickets, generally west of the Missouri River.

A recent examination of North Dakota forest resources (Jakes and Hackett 1981) revealed that the area of commercial forests in the State has declined by over 22,000 ha since 1954. Land clearing was identified as the primary cause for this decline, but forest land lost to reservoir construction was also considered important. The Pembina Hills region was identified by Jakes and Hackett (1981) as one of only three North Dakota areas supporting commercial forests. Forest vegetation and forest soils were also identified as contributing to the State's water quality, and to reduced runoff through infiltration.

Forest resources, especially in North Dakota, are also important for aesthetic reasons. Kantrud (1973) identified two Cavalier County sites as significant natural areas. One of these, the Little North Pembina Gorge, occurred in the study area. Kantrud described the values of that site as "scenic grandeur amid bur oak-American elm-green ash-basswood forest." Important animal species included orange-crowned warbler, rufous-sided towhee, white-throated sparrow, lynx (*Lynx canadensis*), and moose (*Alces alces*). Total area of the site described by Kantrud was 3,887 ha. Among forest habitats in the study area, the presence of black ash was considered unique and unusual. Although black ash is more widespread in the eastern United States, in North Dakota its distribution is restricted to the Pembina Hills region.

Density and diversity of breeding birds was related to the interspersed forest habitat types. The patterns of distribution shown by several species were in response to habitat interspersed. Black-capped chickadees that nested in bur oak and quaking aspen forest were regularly observed foraging in Saskatoon serviceberry thickets. Eastern kingbirds nested at the edge of bur oak forests and fed over various shrub communities and cropland.

In New Jersey hardwoods, Forman et al. (1976) found that increased forest size was responsible for increased numbers of breeding bird species. These authors postulated that the species increases were through the addition of numerous minimum territory size requirements. Whitcomb et al. (1977) reported similar results from Maryland; they attributed high breeding bird densities partly to the interrelationship of forest fragments sufficient to support large numbers of species including wide-ranging groups such as raptors. Large forest tracts are also necessary to attract and maintain rare or uncommon forest species.

The importance of riparian vegetation as habitat for birds has been well established (Anderson and Ohmart 1979; Tubbs 1980). The yearly loss of riparian vegetation across

the United States has been estimated at over 1,000 km² (McCormick, unpubl. rep.). Throughout much of the Great Plains region, riparian habitats are being altered or destroyed to accommodate the increasing demands of society. Tubbs (1980) identified reduced water flows, channelization, and damming of streams for flood control as three important impacts to this community. Stauffer and Best (1980) identified four levels of tolerance to habitat alterations by breeding birds in riparian ecosystems. Among these, bird species with low tolerance to alterations occurred in fewer habitats, and those species were affected most adversely by loss of preferred habitat.

Jakes and Hackett (1981) identified about 5,200 km² of forest vegetation in North Dakota, exclusive of planted shelterbelts and windbreaks. Through 1981, only 424 km² (8.2%) of forest habitat in North Dakota was protected. To maintain maximum species diversity among North Dakota forest birds, large tracts such as the Pembina River gorge deserve protection. Whitcomb (1977) summarized the situation by stating that thousands of contiguous hectares need to be protected to preserve forest-interior bird species. Preservation of large contiguous forest tracts will also preserve forest-edge species by protecting and maintaining maximum interspersions of habitat diversity.

Annotated Species List

In the following annotated list, the taxonomic order follows that of the American Ornithologists' Union (1957) check-list. Current accepted nomenclature follows the check-list, as amended (American Ornithologists' Union 1973, 1976). The status of 121 species that have been recorded on our study area is briefly summarized. Maximum counts, dates of observations, limited data on clutch or brood size, population estimates for species not represented in Table 2, and habitat occupancy are included. All dates are 1981 unless otherwise indicated. Terms used to describe relative abundance of individual species (e.g., common, uncommon, etc.) follow the definitions in Faanes (1981).

FAMILY PODICIPEDIDAE

Pied-billed Grebe (*Podilymbus podiceps*)

One migrant was observed on the Pembina River on 16 April (S. Young, personal communication).

FAMILY PHALACROCORACIDAE

Double-crested Cormorant (*Phalacrocorax auritus*)

A single bird was observed on 16 September along the Pembina River between the Vang Bridge and the Canadian border (S. Young, personal communication).

FAMILY ARDEIDAE

Great Blue Heron (*Ardea herodias*)

Single birds were regularly observed foraging along the banks of the Pembina River during the breeding season. There are no known nesting rookeries in the study area. Large amounts of lowland forest suitable for supporting a rookery exist downstream from Walhalla. Seven great blue herons were observed along the river on 15 September and a single bird 16 September (S. Young, personal communication).

American Bittern (*Botaurus lentiginosus*)

We flushed one bird from the bank of the Little North Pembina River on 30 June. A single bird was observed along the Pembina River on 16 September (S. Young, personal communication).

FAMILY ANATIDAE

Snow Goose (*Chen caerulescens*)

Four flocks totaling about 400 birds were seen 15 April and one flock of about 70 was seen 16 April. A migrant flock of 31 snow geese was seen 15 September and another of unspecified size was observed 16 September (S. Young, personal communication).

Mallard (*Anas platyrhynchos*)

Fairly common nesting species along the Pembina River. A breeding waterfowl pair census conducted by canoe 5–6 May revealed a mean of 1.19 mallard pairs per km of river. The breeding population was estimated at 48 pairs. About 56% of these breeding pairs were observed in the reach of river from the Canadian border to the Vang Bridge. About 27 mallards were found along the Pembina River 15 September (S. Young, personal communication).

Blue-winged Teal (*Anas discors*)

Uncommon nesting species along the Pembina River. A breeding waterfowl pair census conducted by canoe 5–6 May revealed a mean density of 0.27 pair per km of river. The breeding population was estimated at 11 pairs.

American Wigeon (*Anas americana*)

One pair was observed on a beaver impoundment adjacent to the Pembina River on 15 April (S. Young, personal communication).

Wood Duck (*Aix sponsa*)

Uncommon and local nesting species along the Pembina

River. A waterfowl pair census conducted by canoe 5–6 May revealed a mean density of 0.32 pair per km of river. The breeding population was estimated at 13 pairs. Three groups of wood ducks totaling 33 individuals were observed on the Pembina River on 15 September and 4 were observed 16 September.

Common Merganser (*Mergus merganser*)

One pair was observed on the Pembina River on 16 April (S. Young, personal communication).

Hooded Merganser (*Lophodytes cucullatus*)

One pair was found on the Pembina River about 3.2 km downstream from the Canadian border on 8 June.

FAMILY ACCIPITRIDAE

Sharp-shinned Hawk (*Accipiter striatus*)

One pair was observed 28 May flying over a bur oak–green ash forest in Section 33, T. 163 N., R. 58 W. S. Young (personal communication) reported two migrant sharp-shinned hawks on 15 September and single birds on 16 and 17 September.

Cooper's Hawk (*Accipiter cooperi*)

Uncommon and local nesting species throughout the study area. The largest number observed was four on 28 May. The study area breeding population was estimated at eight pairs. During the nesting season, adult Cooper's hawks were consistently observed in five areas that probably represented territories which were associated with the open stands of mixed bur oak–green ash forest.

Red-tailed Hawk (*Buteo jamaicensis*)

Fairly common and regularly observed nesting species. Three active nests were found 22 June. These nests were located in Sections 5, 9, and 10, T. 163 N., R. 58 W. (S. Young, personal communication). The total nesting population for the study area was estimated at 10 pairs. Most nesting pairs were associated with open bur oak–green ash forest. During fall migration, 64 red-tailed hawks were observed 15–17 September.

Broad-winged Hawk (*Buteo platypterus*)

Uncommon nesting species most frequently observed in large expanses of mixed bur oak–quaking aspen forest. The total breeding population was estimated at 10 pairs. Seven migrant broad-winged hawks were observed 15–16 September.

Swainson's Hawk (*Buteo swainsoni*)

Apparently occurs only as a migrant and occasional summer visitor. A single individual was observed on the study area 8 and 11 June. Three migrant Swainson's hawks were observed 16–17 September. Stewart (1975) considered this hawk rare and local on the Agassiz Lake Plain, but fairly common in other regions.

Rough-legged Hawk (*Buteo lagopus*)

A single migrant was observed over the Pembina River gorge on 15 September (S. Young, personal communication).

Golden Eagle (*Aquila chrysaetos*)

A single migrant was observed over the Pembina River gorge on 15 September (S. Young, personal communication).

Marsh Hawk (*Circus cyaneus*)

Rare summer resident, most commonly observed hunting over crop fields on the study area. Three males and one female were regularly seen over various fields in the area from Vang Bridge downstream to the proposed dam site. Probably only one pair nested on the study area.

FAMILY PANDIONIDAE

Osprey (*Pandion haliaetus*)

One adult was observed flying downstream along the Pembina River on 7 June. Salt and Salt (1976) showed that the nearest nesting area in Manitoba was in the lake region near Winnipeg. Green and Janssen (1975) showed the nearest known osprey nesting area in Minnesota as Lake of the Woods County about 225 km east. Stewart (1975) reported a 17 June 1972 observation of an osprey in Walsh County, North Dakota. There is one known nest record for North Dakota.

FAMILY FALCONIDAE

Peregrine Falcon (*Falco peregrinus*)

A single peregrine falcon, probably a female, was observed along the Little North Pembina River in Section 35, T. 163 N., R. 58 W., on 8 September (C. Faanes, personal observation).

American Kestrel (*Falco sparverius*)

Rare and local during summer; probably three pairs nested on the study area. Two pairs were regularly observed in bur oak forest edge near Vang Bridge and along

the Little North Pembina River. A third pair was frequently observed at the edge of a bur oak-quaking aspen forest about 1 km downstream from the Canadian border.

FAMILY TETRAONIDAE

Ruffed Grouse (*Bonasa umbellus*)

Nesting species fairly common and well-distributed throughout the study area. The breeding population was estimated at 126 pairs. During June, six broods averaging 7.5 young per brood were observed. Virtually all mature forest types were occupied by ruffed grouse. Largest breeding densities occurred in mixed quaking aspen-bur oak forest.

FAMILY PHASIANIDAE

Ring-necked Pheasant (*Phasianus colchicus*)

One was heard near the proposed dam site on 4 May (S. Young, personal communication).

Gray Partridge (*Perdix perdix*)

Uncommon and local nesting species in the area downstream from Vang Bridge. Total breeding population was estimated at 10 pairs. An adult with a brood of 11 was seen near the Vang Bridge 16 June. Most gray partridge were observed near the edge of various crop fields adjacent to the Pembina River.

FAMILY MELEAGRIDAE

Wild Turkey (*Meleagris gallopavo*)

Uncommon but an increasing resident throughout the area. The North Dakota Game and Fish Department estimated 250 wild turkeys in 1981. One nest containing 12 eggs was found 14 April in Section 1, T. 162 N., R. 57 W. (S. Young, personal observation). Most observations of adults during the breeding season were in mixed quaking aspen-bur oak forest. Wild turkeys were first released by the North Dakota Game and Fish Department on 15 January 1979. This release, including 5 males and 21 females, was made in Section 30, T. 164 N., R. 58 W. Subsequent releases were made within the Pembina Hills in 1980 and 1981. The 1980 release included 7 males and 22 females in Section 10, T. 162 N., R. 57 W. The 1981 effort included 17 males and 28 females, released about 19 km south of the 1980 site.

FAMILY GRUIDAE

Sandhill Crane (*Grus canadensis*)

Migrant flocks of 50 and 35 sandhill cranes were observed over the Pembina River on 15 and 16 September, respectively (S. Young, personal observation).

FAMILY RALLIDAE

American Coot (*Fulica americana*)

Three individuals were observed on the Pembina River on 4 May (S. Young, personal communication).

FAMILY CHARADRIIDAE

Killdeer (*Charadrius vociferus*)

Uncommon and local nesting species restricted primarily to the area downstream from Vang Bridge. Breeding population was estimated at 15 pairs. Most nesting pairs were associated with fallow fields or sandbars on the Pembina River.

FAMILY SCOLOPACIDAE

Upland Sandpiper (*Bartramia longicauda*)

One adult was heard and then seen flying over a crop field near the proposed dam site on 16 June.

Greater Yellowlegs (*Tringa melanoleuca*)

Two greater yellowlegs were seen on a sandbar upstream from the Vang Bridge on 20 July.

Spotted Sandpiper (*Actitis macularia*)

Uncommon nesting species restricted to sandbars within the channel of the Pembina River. One nest containing three eggs was found on 28 May in Section 30, T. 164 N., R. 58 W. The total breeding population was estimated at 12 pairs.

American Woodcock (*Scolopax minor*)

An adult male was captured and banded on 16 June. The habitat occupied by this bird was young bur oak forest located in Section 18, T. 164 N., R. 58 W. Stewart (1975) considered this species a hypothetical breeder in North Dakota. J. Piehl (personal communication) reported the first North Dakota nest record from Ransom County in 1979. Our observation was the first breeding season record for Cavalier County and the 11th for North

Dakota. Six of the 11 nesting season records have been from northeastern North Dakota.

Common Snipe (*Gallinago gallinago*)

One bird was flushed from the bank of the Pembina River on 3 September.

FAMILY LARIDAE

Ring-billed Gull (*Larus delawarensis*)

A flock of seven ring-billed gulls was observed resting on a plowed field on 22 April.

Franklin's Gull (*Larus pipixcan*)

Flocks of 5–20 Franklin's gulls were observed daily during June as they foraged over agricultural fields from Vang Bridge downstream to the proposed dam site. Stewart (1975) recorded one probable nesting colony in Cavalier County. The nearest known colony is about 80 km southwest of the study area on Sweetwater Lake, Ramsey County.

FAMILY COLUMBIDAE

Rock Dove (*Columba livia*)

One flock of eight rock doves was seen near a farmstead in Section 20, T. 163 N., R. 57 W., on 16 June. No other population data were collected.

Mourning Dove (*Zenaida macroura*)

Fairly common nesting species occurring in virtually all wooded habitats. Highest breeding densities occurred in quaking aspen forest. Five nests were found.

FAMILY CUCULIDAE

Yellow-billed Cuckoo (*Coccyzus americanus*)

Two yellow-billed cuckoos were recorded on 20 July from a bur oak forest in Section 33, T. 163 N., R. 57 W. Stewart (1975) considered the yellow-billed cuckoo a hypothetical nesting species in North Dakota, citing about 10 observations from southeastern or western regions of the State. Recent field work in northeastern North Dakota has revealed several nesting season records, including one along the Turtle River, Grand Forks County, on 15 July 1979.

Black-billed Cuckoo (*Coccyzus erythrophthalmus*)

Fairly common nesting species apparently reaching highest breeding density in mixed bur oak–quaking aspen forest. The study area population was estimated at 71 pairs.

FAMILY STRIGIDAE

Great Horned Owl (*Bubo virginianus*)

Probably a fairly common nesting species throughout the study area. S. Young (personal communication) reported five active nests; three of them contained a total of seven young during June 1981. Most breeding-season adults were observed at the periphery of bur oak–green ash forests. The breeding population was estimated at 10 pairs.

FAMILY TROCHILIDAE

Ruby-throated Hummingbird (*Archilochus colubris*)

Fairly common nesting species throughout the study area. Highest breeding densities were associated with bur oak forest. Two nests were found within 50 m of each other on 20 July.

FAMILY ALCEDINIDAE

Belted Kingfisher (*Megasceryle alcyon*)

Rare and local nesting species restricted primarily to the banks of the Pembina River. Adults were regularly observed foraging along open reaches of the river downstream from the Vang Bridge. This area contained many open hillsides with substrate suitable for nest placement. The study area population was estimated at five pairs.

FAMILY PICIDAE

Common Flicker (*Colaptes auratus*)

Uncommon and local nesting species occurring primarily in open stands of bur oak forest. The breeding population was estimated at 20 pairs.

Pileated Woodpecker (*Dryocopus pileatus*)

Probably a rare nesting species in the study area. R. Stewart (personal communication) found one on 30 June 1962, in T. 164 N., R. 58 W.

Yellow-bellied Sapsucker (*Sphyrapicus varius*)

Fairly common nesting species throughout the study area. The breeding population was estimated at 82 pairs. Largest breeding densities occurred in quaking aspen forest. One nest was found.

Hairy Woodpecker (*Picoides villosus*)

Uncommon nesting species throughout the study area; most frequently observed in mixed bur oak forest. The breeding population was estimated at 15 pairs. Conner et al. (1975) reported that the hairy woodpecker occupied a range of forest types from sparse stands with low basal area to mature forest with high basal area.

Downy Woodpecker (*Picoides pubescens*)

Fairly common nesting species occupying most forested habitats. Largest breeding densities were associated with mixed quaking aspen-green ash forest. Conner et al. (1975) reported highest densities in sparse forest stands with low basal area. Conner and Adkisson (1977) found that the downy woodpecker primarily occupied forest edge. The breeding population in the study area was estimated at 157 pairs.

FAMILY TYRANNIDAE**Eastern Kingbird (*Tyrannus tyrannus*)**

Uncommon nesting species occurring primarily along the edge of forested habitats and agricultural fields and remnant grasslands. The breeding population was estimated at 733 pairs.

Great Crested Flycatcher (*Myiarchus crinitus*)

Fairly common nesting species reaching highest densities in mature quaking aspen forest. Beals (1960) in Wisconsin, reported highest densities from dense forest, and Johnston (1947) in Illinois, found great crested flycatchers nesting in the forest interior. We found an active nesting cavity on 16 June, and on 30 June three young were observed foraging with adults in nearby quaking aspen forest. The breeding population was estimated at 1,178 pairs.

Eastern Phoebe (*Sayornis phoebe*)

Uncommon and local nesting species primarily occurring along and adjacent to the Pembina River and its major tributaries. Three active nests were found beneath highway bridges. Faanes (1980) and others have shown the importance of highway bridges for nest placement. Two pairs were found nesting in more traditional sites, beneath overturned tree roots along streambanks. The breeding population was estimated at 438 pairs.

Alder Flycatcher (*Empidonax alnorum*)

Common nesting species in peach-leaf willow thickets along the Pembina River. The breeding range of this species in North Dakota is restricted to the upper Pembina River Valley and the Turtle Mountains. Two recently fledged young were observed with adults in a willow thicket in Section 19, T. 163 N., R. 57 W., on 21 July, thus establishing the first nesting record for North Dakota. Similar habitat is used by breeding alder flycatchers in Michigan (Berger and Parmalee 1952) and in New York (Stein 1958). In the St. Croix River Valley of Wisconsin and Minnesota, preferred habitat is alder thickets, where speckled alder (*Alnus rugosa*) is predominant (Faanes 1981).

Least Flycatcher (*Empidonax minimus*)

Common nesting species occupying virtually all habitats studied. Stewart (1975) also considered the least flycatcher common in the Pembina Hills region. Highest densities occurred in mature quaking aspen forest where the mean breeding density was 131 pairs/km². Holcomb (1972) reported densities of 148 pairs/km² in upland oak forest with sparse to moderate ground cover.

Eastern Wood Pewee (*Contopus virens*)

Fairly common nesting species throughout the study area. Most numerous in mature quaking aspen forest where the mean density was 375 pairs/km². The breeding population was estimated at 106 pairs. Beals (1960) reported highest densities of this species in mature forest and Bond (1957) reported that mature xeric deciduous forest supported highest breeding densities in Wisconsin.

FAMILY ALAUDIDAE**Horned Lark (*Eremophila alpestris*)**

Uncommon and local nesting species within the study area. Restricted in distribution primarily to recently planted agricultural fields or fallow fields, downstream from Vang Bridge. Stewart (1975) considered the horned lark the primary breeding bird species of North Dakota cropland. The breeding population in the study area was estimated at 50 pairs.

FAMILY HIRUNDINIDAE**Tree Swallow (*Iridoprocne bicolor*)**

Uncommon summer resident. During June, adult tree swallows were frequently observed foraging over the Pembina River and adjacent croplands. Although we collected no population data on this species, or observed any

nest, it undoubtedly nested in the study area. The presence of numerous natural cavities in vegetation adjacent to the river suggests that suitable nesting habitat existed.

Bank Swallow (*Riparia riparia*)

Uncommon and local nesting species. Most breeding pairs were observed below Vang Bridge where the exposed slopes of bluffs along the river provided suitable nest site habitat. The breeding population was estimated at 15 pairs.

Rough-winged Swallow (*Stelgidopteryx ruficollis*)

Uncommon summer resident occurring primarily downstream from Vang Bridge. Foraging adults were occasionally observed along the Pembina River in the heavily forested reaches near the Canadian border. Although no nests were found, this species probably nested in the study area. The presence of suitable bluff faces along the lower reaches of the river suggested that suitable nesting habitat existed there.

Barn Swallow (*Hirundo rustica*)

Fairly common nesting species occurring primarily downstream from Vang Bridge. Most adults were observed foraging over open agricultural fields or near farm buildings. Nests were found beneath both Pembina River bridges and over the Little North Pembina River.

Cliff Swallow (*Petrochelidon pyrrhonota*)

Uncommon summer resident occurring primarily in areas adjacent to the Pembina River. Two nests found beneath the Vang Bridge were the only evidence of nesting obtained. The breeding population was estimated at 10 pairs.

FAMILY CORVIDAE

Blue Jay (*Cyanocitta cristata*)

Fairly common nesting species. Largest breeding densities were recorded in mixed bur oak-quaking aspen forest. The breeding population was estimated at 139 pairs. Anderson and Shugart (1974) described blue jay nesting habitat in Tennessee as deciduous forest with dense understory and a well-developed canopy.

Black-billed Magpie (*Pica pica*)

Apparently a fairly common winter resident and migrant; rare and local during the nesting season. The breeding population was estimated at two pairs. During the nesting season, adults were observed primarily in mature lowland forest.

Common Raven (*Corvus corax*)

Two common ravens were observed at the edge of a quaking aspen forest in Section 13, T. 163 N., R. 58 W. This species was extirpated from North Dakota as a breeding bird in the late 1800's. Stewart (1975) considered recent observations of common ravens in northeastern North Dakota as representative of non-breeding vagrants.

Common Crow (*Corvus brachyrhynchos*)

Fairly common nesting species throughout the study area. Largest breeding densities were associated with mixed quaking aspen-bur oak forest. The breeding population was estimated at 94 pairs.

FAMILY PARIDAE

Black-capped Chickadee (*Parus atricapillus*)

Fairly common nesting species of mature forests. Largest breeding densities were associated with willow shrub and mature quaking aspen forest. Odum (1941) reported that black-capped chickadees occupy a wide range of habitats including second-growth deciduous forest, intermediate seral stages, mature hardwood forest, advanced seral stages, and conifer groves. Two nests containing young were found in bur oak forest 25 May and free-flying young were observed in mid-June.

FAMILY SITTIDAE

White-breasted Nuthatch (*Sitta carolinensis*)

Fairly common permanent resident. Largest breeding densities were recorded in mature quaking aspen forest and in lowland forest. The study area breeding population was estimated at 243 breeding pairs. Anderson and Shugart (1974) described white-breasted nuthatch habitat in east Tennessee as deciduous forest with sparse understory. Stewart (1975) reported that optimum breeding habitat for this species in North Dakota included deciduous upland forest, floodplain forest, and east- or north-facing slopes of river bluffs or escarpments.

FAMILY CETHIIDAE

Brown Creeper (*Certhia familiaris*)

Probably a fairly common spring and fall migrant. Four were observed in mixed quaking aspen-bur oak forest on 22 April.

FAMILY TROGLODYTIDAE

House Wren (*Troglodytes aedon*)

Uncommon and local nesting species. Largest breeding densities (76.9 pairs/km²) were recorded in mature lowland deciduous forest. The study area population was estimated at 148 breeding pairs. Stewart (1975) described house wren breeding habitat in North Dakota as upland and floodplain deciduous woodland, lakeshore forest, and east- or north-facing slopes of river bluffs or escarpments.

FAMILY MIMIDAE

Gray Catbird (*Dumetella carolinensis*)

Common nesting species throughout the study area occupying all forest habitats investigated. Largest densities were recorded in the willow shrub community (250 pairs/km²) and lowland forest (107 pairs/km²). Nickell (1965) found that gray catbird breeding habitat on several study areas in the eastern Great Lakes region included fencerows, dense edge, and shrubby areas near watercourses. In North Dakota, Stewart (1975) described the gray catbird as characteristic of dense thickets of small trees and shrubs that occur in moist situations.

FAMILY TURDIDAE

American Robin (*Turdus migratorius*)

Rare nesting species on the study area. The study area population was estimated at 12 pairs. Stewart (1975) considered this species common as a nesting bird on the Agassiz Lake Plain, and locally common on the Northeastern Drift Plain. Breeding American robins in the Pembina River gorge were restricted primarily to lowland and quaking aspen forests.

Wood Thrush (*Hylocichla mustelina*)

A male was heard singing 21 July in mixed bur oak-green ash forest in Section 32, T. 164 N., R. 58 W. This represented the sixth breeding season record of wood thrush in North Dakota (Lambeth and Lambeth 1979).

Swainson's Thrush (*Catharus ustulatus*)

A single Swainson's thrush was observed in mixed bur oak-green ash forest on 8 September.

Veery (*Catharus fuscescens*)

Common nesting species occupying virtually all forest habitats investigated. Stewart (1975) considered the veery abundant in the Pembina Hills. The largest mean densi-

ties were recorded in willow shrub (130 pairs/km²) and lowland forest (126 pairs/km²). Kendeigh (1945) reported largest densities from late shrub-early tree stage forest in New York. Important characteristics of veery habitat in Connecticut included moist ground, proximity to water, thickets of relatively early successional forest, and high understory cover (Bertin 1977).

FAMILY SYLVIIDAE

Ruby-crowned Kinglet (*Regulus calendula*)

Fairly common migrant; one summer record. During late April, migrant groups of three to five individuals were regularly encountered in most forested habitats. Similar numbers of fall migrant ruby-crowned kinglets were found 8 September. One singing male was recorded on a lowland forest census plot on 7 June; there were no subsequent observations. This probably represented a very late migrant rather than a summer resident.

FAMILY BOMBYCILLIDAE

Cedar Waxwing (*Bombycilla cedrorum*)

Common nesting species throughout the study area. Largest mean breeding densities were recorded in willow shrub (49.9 pairs/km²), lowland forest (45 pairs/km²), and bur oak-green ash forest (40.2 pairs/km²). Stewart (1975) considered the cedar waxwing in North Dakota a characteristic breeding bird of semi-open deciduous woodlands including lowland woods on river floodplains and upland woods on river bluffs, hills, and escarpments.

FAMILY VIREONIDAE

Yellow-throated Vireo (*Vireo flavifrons*)

Uncommon nesting species occurring only in mature bur oak-green ash forest. Mean breeding density in that habitat was 6.5 pairs/km². Bond (1957) reported that open deciduous forest supported the most breeding yellow-throated vireos on his Wisconsin study area. Stewart (1975) characterized North Dakota breeding habitat of this species as mature deciduous forest. The population on the study area was estimated at 284 breeding pairs.

Solitary Vireo (*Vireo solitarius*)

Rare summer resident; the population was estimated at seven pairs. In addition to those observed on the study area, one male was regularly encountered in a black ash forest about 16 km southeast of Walhalla, Pembina County. Stewart (1975) did not mention this vireo as a

nesting species in North Dakota. The range provided in Salt and Salt (1976) suggests that solitary vireos occur during the breeding season throughout southeastern Manitoba, including the region near the North Dakota border. Green and Janssen (1975) show that the Minnesota breeding range of this species includes only the coniferous forest zone of the State. Green and Janssen stated that the western boundary of solitary vireo in Minnesota reaches Itasca State Park, about 220 km southeast of the Pembina River study area. Assuming that the Pembina River population is viable and reproducing, its existence there is unique. Salt and Salt (1976) described nesting habitat of this species in the Canadian prairie provinces as a "mixture of evergreen and deciduous trees with a loose understory of shrubs and bushes. The borders of muskegs often provide this type of habitat."

Red-eyed Vireo (*Vireo olivaceus*)

Common nesting species occupying virtually all forest habitats investigated. Greatest breeding densities were found in lowland forest (100 pairs/km²) and in bur oak forest (62.5 pairs/km²). James (1976) reported greatest densities of red-eyed vireos in closed canopy deciduous forest with abundant understory in southern Ontario. In Wisconsin, Bond (1957) found that breeding habitat included climax mesic deciduous forest.

Philadelphia Vireo (*Vireo philadelphicus*)

Uncommon nesting species. Stewart (1975) stated that the breeding range of this species included only the Turtle Mountains of Bottineau and Rollette counties, and the deltaic sand area of western Pembina County. Thus, our observations establish the Pembina River gorge as one of three known breeding areas in North Dakota. The population was estimated at 71 breeding pairs; all were associated with mature quaking aspen forest. One pair was observed copulating on 7 June.

Warbling Vireo (*Vireo gilvus*)

Fairly common nesting species throughout the study area. Greatest breeding densities were associated with lowland forest (165 pairs/km²) and willow shrub (77 pairs/km²). Stewart (1975) described North Dakota breeding habitat of this species as open stands of floodplain and upland forest containing aspen, cottonwood, and elm. In southern Ontario, James (1976) found that open parkland forest was used by the red-eyed vireo.

FAMILY PARULIDAE

Black-and-white Warbler (*Mniotilta varia*)

Fairly common nesting species restricted primarily to drier upland forest habitats. Largest breeding densities

were recorded in mature quaking aspen forest (50 pairs/km²). The breeding population was estimated at 890 pairs. Stewart (1975) considered the black-and-white warbler in North Dakota a characteristic species of semi-open stands of upland forest composed of immature and second-growth trees. Kendeigh (1945) reported similar habitat use by this species in New York, although Beals (1960) found black-and-white warblers primarily in sugar maple (*Acer saccharum*) forests supporting a dense deciduous understory in Wisconsin.

Golden-winged Warbler (*Vermivora chrysoptera*)

One singing male was observed at the edge of a second-growth bur oak forest in Section 18, T. 163 N., R. 57 W., on 7 June. A pair was seen there on 17 June and on 30 June the female was observed feeding two recently fledged young. This established the first breeding record of the golden-winged warbler in North Dakota. Godfrey (1966) reported that its nesting range in Canada included extreme southern Ontario and the region near Vivian in southern Manitoba. Green and Janssen (1975) reported that golden-winged warblers occur regularly during the nesting season in Minnesota, north to Itasca State Park, Clearwater County. That location is about 220 km southeast of the Pembina River gorge. The habitat used by the nesting pair we observed was similar to that occupied in the normal breeding range. Ficken and Ficken (1968) reported golden-winged warblers in abandoned fields with shrubs and small trees less than 6 m high. Faanes (1981) reported that characteristic nesting habitat in the St. Croix River Valley of Minnesota and Wisconsin included second-growth deciduous forest in early developmental stages.

Tennessee Warbler (*Vermivora peregrina*)

Probably a common spring and fall migrant. We observed this species regularly in bur oak-green ash, quaking aspen, and lowland forests during mid-May. Eight were observed in quaking aspen forest on 8 September.

Orange-crowned Warbler (*Vermivora celata*)

Rare summer resident. Stewart (1975) considered this a hypothetical nesting species in North Dakota based on intermittent observations of three or four singing males in the Pembina River gorge during 1962-71, and a specimen collected in the Turtle Mountains in 1902. Stewart's observations were restricted to SW 1/4, Section 29, T. 164 N., R. 58 W. This location is about 0.8 km south of the Canadian border.

During the 1981 nesting season, we observed or heard 15 singing males in 14 scattered locations in the study area. Although the orange-crowned warbler is not considered a nesting species, Green and Janssen (1975) reported four breeding season records from Minnesota, two

from the northwest region of the State. Salt and Salt (1976) reported that nesting in Manitoba occurs south of the edge of the prairies. Thus, the Pembina Hills population probably includes the southern limit of the Canadian breeding population.

Yellow Warbler (*Dendroica petechia*)

An abundant nesting species that occupied all forest habitats investigated. The largest breeding density was recorded in the willow shrub community (654 pairs/km²). This was nearly 2.6 times greater than the lowland forest, which supported the second highest density (250 pairs/km²). Stewart (1975) described typical yellow warbler nesting habitat in North Dakota as thickets of small deciduous trees or shrubs on moist soils. Ficken and Ficken (1966) reported that greatest breeding densities in their New York study area were associated with shrubby vegetation.

Magnolia Warbler (*Dendroica magnolia*)

An immature male was seen in a bur oak forest on 8 September. More intensive observations during normal migration periods should show this species as a fairly common migrant.

Yellow-rumped Warbler (*Dendroica coronata*)

The yellow-rumped warbler was recorded regularly in all major forest habitats during late April, and two were still present 17 May. Six fall migrants were recorded 8 September.

Chestnut-sided Warbler (*Dendroica pensylvanica*)

Rare and local nesting species restricted to early successional stages of young bur oak forest and serviceberry thickets. The breeding population was estimated at 56 breeding pairs. Stewart (1975) reported that this species occurs in North Dakota during the breeding season only in the Turtle Mountains of Bottineau and Rollette counties, and in the Pembina Hills.

Palm Warbler (*Dendroica palmarum*)

Probably an uncommon migrant. Three individuals were observed 17 May in willow shrub habitat along the Pembina River, and two were seen in similar habitat on 8 September.

Ovenbird (*Seiurus aurocapillus*)

Rare and local nesting species within the study area. Stewart (1975) considered the ovenbird uncommon throughout the Pembina Hills and in the deltaic sand area of western Pembina County. Although none were recorded on census plots, we estimate the population at 25 pairs, based on extensive observations throughout the area. Most breeding pairs were encountered in mesic quaking aspen forests, especially on north-facing slopes.

These situations were similar to the mature forests with dense understory described by Beals (1960) for the ovenbird in northern Wisconsin.

Northern Waterthrush (*Seiurus noveboracensis*)

Fairly common nesting species usually associated with early seral stage communities on wet soils. Greatest breeding densities occurred in the willow shrub community (115 pairs/km²). Occasional pairs were also encountered in wet areas of quaking aspen forest. Faanes (1981) reported that primary habitat use included alder thickets and northern sedge meadows that are becoming invaded with various shrubs including dogwood in the St. Croix River Valley of Minnesota and Wisconsin. The study area population was estimated at 287 breeding pairs.

Mourning Warbler (*Oporornis philadelphia*)

Fairly common nesting species of mesic upland habitats. Largest breeding densities were found in early seral stage bur oak (22.7 pairs/km²) and in quaking aspen (25 pairs/km²) forests. The breeding population was estimated at 566 pairs. Cox (1960) reported that nesting habitat in northern Michigan included deciduous or coniferous forests with partially open canopy, and the presence of herbs and shrubs in the ground layer. In North Dakota, the mourning warbler is restricted as a nesting species to the Turtle Mountains and the Pembina Hills (Stewart 1975).

Common Yellowthroat (*Geothlypis trichas*)

Common nesting species reaching maximum breeding densities in early seral stage deciduous habitats. Largest densities were recorded in serviceberry thickets (250 pairs/km²) and in the willow shrub community (211 pairs/km²). The lowest density (2.5 pairs/km²) was recorded in lowland forest. Stewart (1953) reported that largest densities of common yellowthroats on his Michigan study area were associated with dense shrubs and small trees growing on wet soils.

Wilson's Warbler (*Wilsonia pusilla*)

Probably an uncommon migrant. Single birds were observed in serviceberry thickets on 17 May and 8 September.

Canada Warbler (*Wilsonia canadensis*)

One pair was observed regularly throughout the breeding season in Section 32, T. 164 N., R. 58 W. The habitat occupied by this pair was the brushy ecotone between a bur oak and quaking aspen forest. Both Beals (1960) and Faanes (1981) reported similar habitat use in Wisconsin and Minnesota.

Our observations of this pair are the first breeding season records of the Canada warbler in North Dakota

since 1917 (Stewart 1975). Green and Janssen (1975) reported that Canada warblers have nested in Minnesota as far west as Itasca State Park, Clearwater County. Godfrey (1966) showed that the breeding range in Manitoba included the extreme southeastern corner of that Province. Thus, if a viable breeding population of Canada warblers exists in the study area, it probably represents an overlooked extension of the main Canadian population.

American Redstart (*Setophaga ruticilla*)

Common nesting species of dry upland forest habitats. This was the second most abundant breeding bird on the study area. Stewart (1975) considered the American redstart fairly common throughout the Pembina Hills region. The largest breeding density was recorded in mature bur oak forest (180 pairs/km²). Kendeigh (1945) reported largest densities from open, second-growth deciduous forest. Stewart (1975) described North Dakota habitats used by this bird as floodplain or upland mesophytic deciduous forest, particularly second-growth stands.

FAMILY PLOCEIDAE

House Sparrow (*Passer domesticus*)

Fairly common nesting species associated with active and abandoned farmsites. No population data were gathered.

FAMILY ICTERIDAE

Bobolink (*Dolichonyx oryzivorus*)

Three singing males were recorded throughout the nesting season in an alfalfa field near the proposed dam site. No other population data were recorded from the study area. This species was common in seeded grasslands and other similar vegetation away from the Pembina River gorge.

Western Meadowlark (*Sturnella neglecta*)

Rare and local within the study area, although common and well-distributed in seeded grasslands and cropland away from the Pembina River gorge. Based on observations throughout the study area, the breeding population was estimated at 15 territorial males.

Red-winged Blackbird (*Agelaius phoeniceus*)

Uncommon and local nesting species throughout the study area. The study area population was estimated at 284 territorial males. Breeding pairs on census plots were recorded only in the willow shrub community. Scattered pairs were also found associated with cattail (*Typha* sp.) vegetation along the periphery of small woodland ponds

throughout the upper reaches of the gorge. Four nests, each containing four eggs, were found during June.

Northern Oriole (*Icterus galbula*)

Uncommon nesting species restricted to quaking aspen forests where the mean density was 25 pairs/km². The study area population was estimated at 142 pairs. Stewart (1975) stated that the primary breeding habitat in North Dakota included wooded stream valleys and upland forests on prominent hills and escarpments. Bond (1957) reported that largest densities in southern Wisconsin were associated with early-age forests.

Common Grackle (*Quiscalus quiscula*)

Not recorded as a breeding bird within the study area, although some nesting may have occurred. Most observations of this species were of adults foraging in and adjacent to crop fields.

Brown-headed Cowbird (*Molothrus ater*)

Fairly common nesting species observed in all wooded habitats investigated. The study area breeding population was estimated at 1,025 females. Largest breeding densities were recorded in the willow shrub community and in serviceberry thickets where the densities were identical (77 pairs/km²).

FAMILY THRAUPIDAE

Scarlet Tanager (*Piranga olivacea*)

Common nesting species in mesic upland forest habitats. Largest breeding densities were in mixed bur oak-green ash (23.5 pairs/km²). Anderson and Shugart (1974) characterized scarlet tanager habitat in Tennessee as deciduous forest with dense canopy cover. Beals (1960) found them in dense deciduous forests in northern Wisconsin.

FAMILY FRINGILLIDAE

Rose-breasted Grosbeak (*Pheucticus ludovicianus*)

Fairly common nesting species of late seral stage deciduous habitats. Largest breeding densities in lowland forest (67 pairs/km²) were over 3 times greater than densities in bur oak forest (19 pairs/km²). Stewart (1975) described the breeding habitat of this species as semi-open mesophytic deciduous forest.

Indigo Bunting (*Passerina cyanea*)

Fairly common nesting species associated primarily with the edge of second-growth bur oak forest. Mean breed-

ing density in that habitat was 28 pairs/km². Bond (1957) reported that highest breeding densities in southern Wisconsin were in open xeric forest, and in forest edge.

Purple Finch (*Carpodacus purpureus*)

Several singing males were observed in willow shrub along the Pembina River on 22 April. One male was still found there on 17 May. There were no summer observations.

Pine Siskin (*Carduelis pinus*)

Flocks of 6–20 pine siskins were encountered throughout the study area 22 April and 15–17 May. One male was recorded on a lowland forest census plot on 7 June. We found no evidence of nesting in the study area although pine siskins occurred throughout the summer in coniferous trees in the village of Walhalla, about 4 km east of the study area.

American Goldfinch (*Carduelis tristis*)

Common nesting species occupying all forested habitats investigated. Largest breeding densities were recorded in early seral stage deciduous habitats including serviceberry thickets (115 pairs/km²) and willow shrub community (69 pairs/km²). Stewart (1975) described the breeding habitat of this species in North Dakota as marginal zones of woodlands and brushland. Faanes (1981) classified this species as typical of edge habitats in the St. Croix River Valley of Minnesota and Wisconsin.

Red Crossbill (*Loxia curvirostra*)

A flock of six red crossbills was observed in mixed bur oak–green ash forest on 22 July. No evidence of nesting was obtained.

Rufous-sided Towhee (*Pipilo erythrophthalmus*)

Common nesting species of mesic and xeric upland habitats. The largest breeding density was recorded in mixed bur oak–green ash forest (38 pairs/km²). Stewart (1975) described the breeding habitat of the rufous-sided towhee in North Dakota as semi-open upland deciduous forest with a fairly dense understory of small trees and tall shrubs.

Savannah Sparrow (*Passerculus sandwichensis*)

The savannah sparrow was occasionally observed foraging in scattered prairie remnants on the edge of bluffs, primarily downstream from Vang Bridge. We obtained no evidence of nesting in the study area, although the species was fairly common in seeded grasslands adjacent to the study area.

Vesper Sparrow (*Pooecetes gramineus*)

Uncommon and local nesting species usually associated with the brushy ecotone between young bur oak forest and cropland. The study area population was estimated at 246 breeding pairs. Bent (1968) reported that roadsides, open grassy and weedy areas, and hayfields or stubble were commonly used habitats in much of its range.

Dark-eyed Junco (*Junco hyemalis*)

Probably a common spring and fall migrant. Most field work did not coincide with the normal peak periods of migration for this species. During late April, individual flocks of four to eight dark-eyed juncos were regularly encountered in early seral stage forests.

Tree Sparrow (*Spizella arborea*)

Probably a common to abundant migrant during normal migrant periods. Groups of 8–20 tree sparrows were regularly observed in willow shrub and bur oak forest during late April, and some stragglers were still present on 15 May.

Chipping Sparrow (*Spizella passerina*)

Two singing males were observed throughout June in mixed bur oak and quaking aspen forest near the proposed dam site. It was unknown if these birds represented breeding pairs, primarily because of the lack of suitable coniferous trees.

Clay-colored Sparrow (*Spizella pallida*)

Common nesting species throughout the study area occurring in all forested habitats investigated. This was the third most abundant breeding species in the study area. Largest breeding densities were recorded in serviceberry thickets (115 pairs/km²). Fox (1961) described this species as characteristic of wolfberry thickets on prairie grasslands. Faanes (1981) described breeding habitat in the eastern part of their range as edge situations including brushy fields, retired agricultural fields, and old field communities that were invaded with coarse perennial weeds, and brushy open areas in oak forest.

White-crowned Sparrow (*Zonotrichia leucophrys*)

Groups of three to five migrants were frequently encountered in various edge habitats during late April.

White-throated Sparrow (*Zonotrichia albicollis*)

Fairly common migrant during late April to mid-May when solitary birds and groups of two to four were found in various early seral stage forests. Stewart (1975) considered this a rare nesting species in the Pembina Hills, and showed a breeding season record for T. 164 N., R. 58 W. obtained 30 June 1962. Although apparently suit-

able breeding habitat existed in the study area, we found no evidence of nesting.

Lincoln's Sparrow (*Melospiza lincolnii*)

Solitary migrants were observed in the study area during 15–17 May, and on 8 September.

Song Sparrow (*Melospiza melodia*)

Fairly common nesting species occurring in all forested habitats investigated. Largest breeding densities were recorded in the willow shrub community (269 pairs/km²). Beals (1960) reported highest nesting densities in northern Wisconsin from pioneer stage aspen forest. Roberts (1932) considered the song sparrow a characteristic species of brushy meadows, the banks of lakes and streams, prairie groves, upland fields, and clearings in Minnesota.

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A list of current *Resource Publications* follows.

133. A Handbook for Terrestrial Habitat Evaluation in Central Missouri, edited and compiled by Thomas S. Bassett, Deretha A. Darrow, Diana L. Hallett, Michael J. Armbruster, Jonathan A. Ellis, Bettina Flood Sparrowe, and Paul A. Korte. 1980. 155 pp.
134. Conservation of the Amphibia of the United States: A Review, by R. Bruce Bury, C. Kenneth Dodd, Jr., and Gary M. Fellers. 1980. 34 pp.
135. Annotated Bibliography for Aquatic Resource Management of the Upper Colorado River Ecosystem, by Richard S. Wydoski, Kim Gilbert, Karl Seethaler, Charles W. McAda, and Joy A. Wydoski. 1980. 186 pp.
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